

1. An apparatus for acquiring, lifting and transferring a container so as to deposit its contents in a collection bin, said apparatus comprising:
  - (a) a container grab assembly which includes a pair of opposed grabbing arms that are aligned in spaced relationship and operable by a fluid-operated actuating system to grab and release a container;
  - (b) an articulated, moveable arm assembly that is operable by a fluid-operated actuating system through an operating cycle that includes retracted, extended, lifting and dumping positions, which arm assembly includes:
    - (i) a base link that is mounted adjacent to the collection bin;
    - (ii) an upper link having a first end and a second end
    - (iii) a reach link having a first end and a second end, said first end being pivotally attached to the base link and said second end being pivotally attached to the upper link at a first intermediate position between the first end of the upper link and the second end;
    - (iv) a lift arm having a first end and a second end, one of which is pivotally attached to the grab assembly;

wherein the base link, upper link, reach link and lift arm are arranged and interconnected so that said upper link remains generally parallel to the base link throughout the operating cycle of the arm assembly.
2. The apparatus of claim 1 which is mounted onto a refuse collection vehicle adjacent to the collection bin.

3. The apparatus of claim 1 wherein the actuating system for the container grab assembly and the actuating system for the arm assembly comprise double-acting hydraulic cylinders.
4. The apparatus of claim 1 wherein the grab assembly includes:
  - (a) a side support arm having a first end and a second end, the first end of which is attached to the lift arm;
  - (b) a gear box that is mounted on the second end of the side support arm, which gear box includes a left gear and a right gear that are meshed together;
  - (c) a right shaft on which the right gear is mounted;
  - (d) a left shaft on which the left gear is mounted;
  - (e) a drive link having a first end and a second end, with said first end being mounted on the right shaft;
  - (f) a left grabbing arm which is mounted on the left shaft;
  - (g) a right grabbing arm that is mounted on the right shaft;
  - (h) a grabber cylinder having a base end and a rod end, with one of such ends being pivotally attached to the first end of the side support arm and the other being pivotally attached to the second end of the drive link.
5. The apparatus of claim 4 wherein the relative positions of the drive link, the left and right gears and the left and right grabbing arms are such that retraction of the rod of the grabber cylinder from an extended position to a retracted position will cause the grabbing arms to close from an open position to a grab position.

6. The apparatus of claim 4 wherein:

- (a) the gear box is enclosed and has a first side and a second side;
- (b) the right shaft extends through both the first and second sides of the gear box;
- (c) the left shaft extends through the second side of the gear box;
- (c) the second end of the drive link is mounted on the right shaft on the first side of the gear box;
- (d) the right grabbing arm is mounted on the right shaft on the second side of the gear box;
- (e) the left grabbing arm is mounted on the left shaft on the second side of the gear box.

7. An apparatus for acquiring, lifting and transferring a container so as to deposit its contents in a collection bin mounted on a refuse collection vehicle, said apparatus comprising:

- (a) a base link having a first end and a second end, which base link is mounted on the collection vehicle;
- (b) a container grab assembly that is adapted to capture the container;
- (b) an upper link having a first end and a second end;
- (c) a reach link having a first end and a second end, said first end being pivotally attached to the first end of the base link and said second end being pivotally attached to the upper link at an intermediate position between the first end and the second end;

- (d) a lift arm having a first end and a second end, said first end being pivotally attached to the grab assembly;
- (e) a reach cylinder having a base end and a rod end, with one of such ends being pivotally attached to the second end of the base link and the other being pivotally attached to the second end of the upper link;
- (f) a lift cylinder having a base end and a rod end, with one of such ends being pivotally attached to the base link at an intermediate position between the first end and the second end and the other being pivotally attached to the second end of the lift arm.

8. The apparatus of claim 7 which includes:

- (e) a reach cylinder having:
  - (i) a base end and a rod end, with one of such ends being pivotally attached to the second end of the base link and the other being pivotally attached to the second end of the upper link;
  - (ii) an extend port through which hydraulic fluid may be introduced to extend the rod end;
  - (iii) a retract port through which hydraulic fluid may be introduced to retract the rod end;
- (f) a lift cylinder having:
  - (i) a base end and a rod end, with one of such ends being pivotally attached to the base link at an intermediate position between the first end and the

second end and the other being pivotally attached to the second end of the lift arm;

- (ii) an extend port through which hydraulic fluid may be introduced to extend the rod end;
  - (iii) a retract port through which hydraulic fluid may be introduced to retract the rod end;
- (g) means for directing hydraulic fluid in parallel flow to the extend port of the reach cylinder and extend port of the lift cylinder to move the grab assembly from a first position adjacent to the base to a second position adjacent to the container;
- (h) means for directing hydraulic fluid in parallel flow to the retract port of the reach cylinder and extend port of the lift cylinder to move the grab assembly from the second position adjacent to the container to a third position adjacent to the collection bin;
- (i) means for directing hydraulic fluid in parallel flow to the extend port of the reach cylinder and retract port of the lift cylinder to move the grab assembly from the third position adjacent to the collection bin to the second position;
- (j) means for directing hydraulic fluid in parallel flow to the retract port of the reach cylinder and retract port of the lift cylinder to move the grab assembly from the second position to the first position.

9. The apparatus of claim 7 which includes:

- (a) an upper link having a first end, a second end and a first and second intermediate positions between the first end and the second end, wherein said first intermediate

position is nearer to the first end than the second end;

- (b) a slave cylinder having a base end and a rod end, with one of such ends being pivotally attached to the reach link at an intermediate position between the first end and the second end, and the other being pivotally attached to the upper link at the first intermediate position;

and wherein the second end of the reach link is pivotally attached to the upper link at the second intermediate position.

10. The apparatus of claim 7 wherein the grab assembly includes:

- (a) a side support arm having a first end and a second end, the first end of which is attached to the lift arm;
- (b) a gear box that is mounted on the second end of the side support arm and including a left gear and a right gear that are meshed together;
- (c) a right shaft on which the right gear is mounted;
- (d) a left shaft on which the left gear is mounted;
- (e) a drive link having a first end and a second end, with said first end being mounted on the right shaft;
- (f) a left grabbing arm which is mounted on the left shaft;
- (g) a right grabbing arm that is mounted on the right shaft;
- (h) a grabber cylinder having a base end and a rod end, with one of such ends being pivotally attached to the first end of the side support arm and the other being pivotally attached to the second end of the drive link.

11. The apparatus of claim 10 wherein the relative positions of the drive link, the left and right gears and the left and right grabbing arms are such that retraction of the rod of the grabber cylinder from an extended position to a retracted position will cause the grabbing arms to close from an open position to a grab position.
12. The apparatus of claim 10 wherein:
  - (a) the gear box is enclosed and has a first side and a second side;
  - (b) the right shaft extends through both the first and second sides of the gear box;
  - (c) the left shaft extends through the second side of the gear box;
  - (c) the second end of the drive link is mounted on the right shaft on the first side of the gear box;
  - (d) the right grabbing arm is mounted on the right shaft on the second side of the gear box;
  - (e) the left grabbing arm is mounted on the left shaft on the second side of the gear box.
13. An apparatus for lifting a container and moving the container so as to deposit its contents in a collection bin, said apparatus comprising:
  - (a) a container grab assembly that is adapted to grab the container;
  - (b) a right base link, a middle right base link, a middle left base link and a left base link, said links being disposed in parallel relation to each other with each having a first end and a second end;

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- (c) an upper link having a first end and a second end and a first and second intermediate positions between the first end and the second end, wherein said first intermediate position is nearer to the first end than the second end;
  - (d) a lift arm having a first end and a second end, said first end being pivotally attached to the grab assembly;
  - (e) a left reach link having a first end and a second end, said first end being pivotally attached to the first end of the middle left and left base links and said second end being pivotally attached to the upper link at the first intermediate position;
  - (f) a right reach link having a first end and a second end, said first end being pivotally attached to the first end of the middle right and right base links and said second end being pivotally attached to the lift arm at an intermediate position between the first end of the lift arm and the second end of the lift arm;
  - (g) a secondary reach link having a first end and a second end, said first end being pivotally attached to the middle left and left base links at a first intermediate position between the first end of the middle left and left base links and the second end of the middle left and left base links, and said second end being pivotally attached to the second end of upper link;
  - (h) a clevis link which is attached to the second end of the secondary reach link, which clevis link has a first end and a second end;
  - (i) a grabber support arm having a first end and a second end, said first end being pivotally attached to the grab assembly and said second end being pivotally attached to the first end of the upper link;
  - (j) a reach actuator having:



- (i) a base end and a rod end, with one of such ends being pivotally attached to the second end of the middle left and left base links and the other being pivotally attached to the first end of the clevis link;
- (ii) an extend port through which hydraulic fluid may be introduced to extend the rod end;
- (iii) a retract port through which hydraulic fluid may be introduced to retract the rod end;
- (k) a lift actuator having:
  - (i) a base end and a rod end, with one of such ends being pivotally attached to the middle right and middle left base links at an intermediate position between the first end of the middle right and middle left base links and the second end of the middle right and middle left base links, and the other being pivotally attached to the second end of the lift arm;
  - (ii) an extend port through which hydraulic fluid may be introduced to extend the rod end;
  - (iii) a retract port through which hydraulic fluid may be introduced to retract the rod end;
- (l) means for directing hydraulic fluid in parallel flow to the extend port of the reach actuator and the extend port of the lift actuator to move the grab assembly from a first position adjacent to the base to a second position adjacent to the container;
- (m) means for directing hydraulic fluid in parallel flow to the retract port of the reach actuator and the extend port of the lift actuator to move the grab assembly from

the second position adjacent to the container to a third position adjacent to the collection bin;

- (n) means for directing hydraulic fluid in parallel flow to the extend port of the reach actuator and the retract port of the lift actuator to move the grab assembly from the third position adjacent to the collection bin to the second position;
- (o) means for directing hydraulic fluid in parallel flow to the retract port of the reach actuator and the retract port of the lift actuator to move the grab assembly from the second position to the first position.

14. The apparatus of claim 13 which includes:

- (a) an upper link having a first end, a second end and a first and second intermediate positions between the first end and the second end, wherein said first intermediate position is nearer to the first end than the second end;
- (b) a slave cylinder having a base end and a rod end, with one of such ends being pivotally attached to the left reach link at an intermediate position between the first end and the second end, and the other being pivotally attached to the upper link at the first intermediate position;

and wherein the second end of the reach link is pivotally attached to the upper link at the second intermediate position.

15. The apparatus of claim 13 wherein:

- (a) the grab assembly includes:
  - (i) a grab link having a first end and a second end;

- (ii) a gear box having a left gear and a right gear that are meshed together;
- (iii) a side support arm having a first end and a second end, the first end of which is attached to the first end of the grab link of the lift arm, and to the second end of which is mounted the gear box;
- (iv) a right shaft on which the right gear is mounted;
- (v) a left shaft on which the left gear is mounted;
- (vi) a drive link having a first end and a second end, with said first end being mounted on the right shaft;
- (vii) a left grabbing arm which is mounted on the left shaft;
- (viii) a right grabbing arm that is mounted on the right shaft;
- (ix) a grabber cylinder having a base end and a rod end, with one of such ends being pivotally attached to the first end of the side support arm and the other being pivotally attached to the second end of the drive link;
- (b) the first end of the grabber support arm is pivotally attached to the second end of the grab link, and the second end of the grabber support arm is attached to the first end of the upper right link.

16. The apparatus of claim 15 wherein the relative positions of the drive link, the left and right gears and the left and right grabbing arms are such that retraction of the rod of the grabber cylinder from an extended position to a retracted position will cause the grabber arms to close from an open position to a grab position.

17. The apparatus of claim 15 wherein:

- (a) the gear box is enclosed and has a first side and a second side;
- (b) the right shaft extends through both the first and second sides of the gear box;
- (c) the left shaft extends through the second side of the gear box;
- (c) the second end of the drive link is mounted on the right shaft on the first side of the gear box;
- (d) the right grabbing arm is mounted on the right shaft on the second side of the gear box;
- (e) the left grabbing arm is mounted on the left shaft on the second side of the gear box.

18. A refuse collection vehicle having a front and a rear and comprising:

- (a) a frame;
- (b) a collection bin mounted on the frame;
- (c) an apparatus for acquiring, lifting and transferring a container so as to deposit the contents of the container in the collection bin;
- (d) a collection compartment that is pivotally mounted on the rear of the vehicle;
- (e) a storage compartment that is mounted on the frame between the collection bin and the collection compartment;
- (f) a packer blade that is mounted within the collection compartment;
- (g) means for moving the packer blade within the collection compartment so as to move refuse from the collection compartment into the storage compartment.

19. The refuse collection vehicle of claim 18 wherein the apparatus for acquiring, lifting and transferring a container so as to deposit its contents in the collection bin comprises:
- (a) a container grab assembly which includes a pair of opposed grabbing arms that are aligned in spaced relationship and operable by a fluid-operated actuating system to grab and release a first container;
  - (b) an articulated, moveable arm assembly that is operable by a fluid-operated actuating system through an operating cycle that includes retracted, extended, lifting and dumping positions, which arm assembly includes:
    - (i) a base link that is mounted adjacent to the collection bin;
    - (ii) an upper link having a first end and a second end
    - (iii) a reach link having a first end and a second end, said first end being pivotally attached to the base link and said second end being pivotally attached to the upper link at a first intermediate position between the first end of the upper link and the second end;
    - (iv) a lift arm having a first end and a second end, said first end being pivotally attached to the grab assembly and said second end being pivotally attached to the first end of the upper link;

wherein the base link, upper link, reach link and lift arm are arranged and interconnected so that said upper link remains generally parallel to the base link throughout the operating cycle of the arm assembly.

20. The refuse collection vehicle of claim 18 wherein the apparatus for acquiring, lifting and transferring a container so as to deposit its contents in the collection bin is adapted to acquire, lift, transfer and deposit the contents of a container having a pair of sleeves to accommodate a pair of forks, said apparatus comprising a pair of lifting arms that are aligned in spaced relationship, one on each side of the frame, with each such lifting arm having:

- (a) a first end that is pivotally attached to the frame;
- (b) a second end, to which a fork is pivotally attached, said fork being adapted to engage the sleeves of the container to acquire the container;
- (c) a first fluid-operated actuator that is adapted to pivot the fork about the second end of the lifting arm;
- (d) a second fluid-operated actuator that is adapted to pivot the lifting arm at its first end with respect to the frame.